**Instruction Manual**

# Model 2533 Digital Power Meter RS-232-C Communications-Interface

IM 2533-70E
3rd Edition

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YOKOGAWA
Yokogawa Electric Corporation

# Model 2533
# Digital Power Meter
# RS-232-C Communications-Interface

IM 2533-70E
3rd Edition

# INTRODUCTION

This Instruction Manual describes the RS-232-C interface which is an option board for the Model 2533 Precision Digital Power Meter. Read this manual together with Instruction Manual for Model 2533 Precision Digital Power Meter in order to make effective use of this board. In addition, it is necessary to fully understand RS-232-C communication procedures using a personal computer in order to become proficient with interface handling.

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# 1. OUTLINE AND SPECIFICATIONS

## 1.1 Outline

The RS-232-C interface is a standard set by Electronic Industry Association (EIA) for communications protocol between a data terminal (DTE) and a modem (DCE). It is generally used for communications utilizing telephone lines.

The digital power meter Model 2533 can be remotely controlled to set voltage or current ranges, to select digital displays, to output measurement/computation data, or to output setting data and errors by connecting a personal computer to the RS-232-C interface.

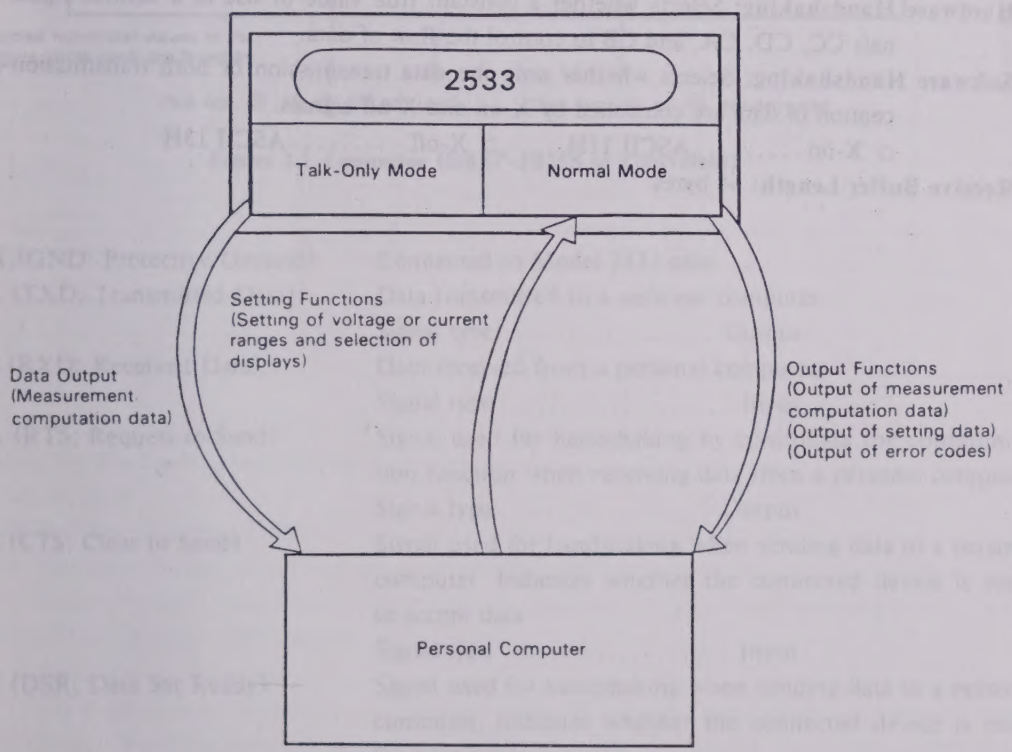



**Figure 1.1 Communications between Model 2533 Power Meter and Personal Computer**

## 1.2 Specifications

- **Connecting Method:** Point to point
- **Communications System:** Full duplex
- **Synchronizing System:** Start/stop system
- **Transmission Rate:** 75, 150, 300, 600, 1200, 2400, 4800, and 9600 bps
  (Specify one from the above.)
- **Start Bit:** 1 bit
  The start bit is fixed at 1 bit.
- **Data Length (word length):** 7 or 8 bits
  Specify either 7 or 8 bits as the number of bits for the data.
- **Parity:** EVEN, ODD, or No Parity
  Specify any one of the above three.
- **Stop Bit:** 1 bit or 2 bits
  Specify either of the above.
- **Electrical Characteristics:** Conform to EIA RS-232-C standard
- **Connector:** DBSP-JB25S (JAE) (Mounted on the rear panel of the power meter)
  To attach a connector to RS-232-C interface, use cable DB-25P or equivalent.
- **Hardware Handshaking:** Selects whether a constant true value or use as a control signal for signals CC, CD, CA, and CB to control the flow of data.
- **Software Handshaking:** Selects whether only the data transmission or both transmission and reception of data are controlled by X-on and X-off signals.
  ○ X-on ..... ASCII 11H, ○ X-off..... ASCII 13H
- **Receive Buffer Length:** 64 bytes

# 2. MODEL 2533 BUILT-IN RS-232-C INTERFACE

## 2.1 Connector and Signal Names

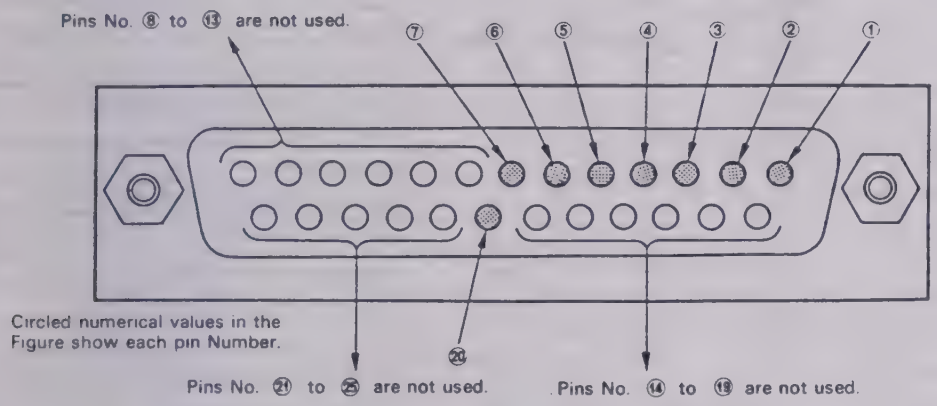

Pins No. ⑧ to ⑬ are not used.
⑦ ⑥ ⑤ ④ ③ ② ①
Circled numerical values in the Figure show each pin Number.
⑳
Pins No. ㉑ to ㉕ are not used.
Pins No. ⑭ to ⑲ are not used.

**Figure 2.1 Connector (DBSP-JB25S or Equivalent)**

| | | |
|---|---|---|
| ① | AA (GND; Protective Ground): | Connected to Model 2533 case |
| ② | BA (TXD; Transmitted Data): | Data transmitted to a personal computer.<br>Signal type ..... Output |
| ③ | BB (RXD; Received Data): | Data received from a personal computer.<br>Signal type ..... Input |
| ④ | CA (RTS; Request to Send): | Signal used for handshaking by controlling the communication function when receiving data from a personal computer.<br>Signal type ..... Output |
| ⑤ | CB (CTS; Clear to Send): | Signal used for handshaking when sending data to a personal computer. Indicates whether the connected device is ready to accept data.<br>Signal type ..... Input |
| ⑥ | CC (DSR; Data Set Ready): | Signal used for handshaking when sending data to a personal computer. Indicates whether the connected device is ready for operation.<br>Signal type ..... Input |
| ⑦ | AB (GND; Signal Ground): | Ground for electrical circuits |
| ⑳ | CD (DTR; Data Terminal Ready): | Signal used for handshaking when receiving data from a personal computer. Indicates to the personal computer that the power meter is ready to receive data.<br>Signal type ..... Output |

(Note) Pins ⑧ to ⑲ and ㉑ to ㉕ are not used.

[Reference] The following shows a list of the signals prescribed in RS-232-C and codes prescribed by CCITT and JIS.

**Table 2.1 List of Signals**

| Pin No. (25 pin connector) | Codes | | | Name |
|---|---|---|---|---|
| | RS-232-C | CCITT | JIS | |
| 1 | AA (GND) | 101 | FG | Protective ground |
| 7 | AB (GND) | 102 | SG | Signal ground |
| 2 | BA (TXD) | 103 | SD | Transmitted data |
| 3 | BB (RXD) | 104 | RD | Received data |
| 4 | CA (RTS) | 105 | RS | Request to send |
| 5 | CB (CTS) | 106 | CS | Clear to send |
| 6 | CC (DSR) | 107 | DR | Data set ready |
| 20 | CD (DTR) | 108/2 | ER | Data terminal ready |
| 22 | CE (RI) | 125 | CI | Ring indicator |
| 8 | CF (DCD) | 109 | CD | Received line signal detector |
| 21 | CG ( – ) | 110 | SQD | Signal qualify detector |
| 23 | CH/CI ( – ) | 111 | SRS | Data signal rate selector |
| 24/15 | DA/DB (TXC) | 113/114 | ST1/ST2 | Transmitter signal element timing |
| 17 | DD (RXC) | 115 | RT | Receiver signal element timing |
| 14 | SBA ( – ) | 118 | BSD | Auxiliary transmitted data |
| 16 | SBB ( – ) | 119 | BRD | Auxiliary received data |
| 19 | SCA ( – ) | 120 | BRS | Auxiliary request to send |
| 13 | SCB ( – ) | 121 | BCS | Auxiliary clear to send |
| 12 | SCF ( – ) | 122 | BCD | Auxiliary receive line signal detector |

# 2.2 Combination of Handshaking Schemes and Setting Procedure

## (1) Combination of Handshaking Schemes

When the 2533 power meter is connected to a personal computer via the RS-232-C interface, a number of procedures are executed by electrical signals between transmitter and receiver so that data can be correctly exchanged. These procedures are called handshaking. Since there are many handshaking schemes used in connecting personal computers, the scheme in Model 2533 power meter and the personal computer must match. In the 2533 power meter, one out of eight modes can be selected with DIP switch as shown in Table 2.2.

**Table 2.2 Handshaking Schemes**

(○ ..... Function provided)

| Mode Selection No. | Transmission data control (control method used when data is sent to a personal computer) | | | | Receive data control (control method used when receiving data from a personal computer) | | | |
|---|---|---|---|---|---|---|---|---|
| | Software Handshaking | Hardware Handshaking | | No Handshaking | Software Handshaking | Hardware Handshaking | | No Handshaking |
| | Transmission stops when X-off is received. Transmission restarts when X-on is received. | Transmission stops with CB (CTS) false and resumes with CB true. | Transmission stops with CC (DSR) false and resumes with CC true. | | X-off is sent when the receive buffer becomes 3/4 full, and X-on is sent when the buffer is only 1/4 full. | CD (DTR) goes false when the receive buffer is 3/4 full and true when the buffer is only 1/4 full. | CA (RTS) goes false when the receive buffer is 3/4 full. It goes true when the buffer is only 1/4 full. | |
| 0 | | | | ○ | | | | ○ |
| 1 | ○ | | | | ○ | | | |
| 2 | ○ | | | | | ○ | | |
| 3 | ○ | | | | | | ○ | |
| 4 | | ○ | | | | ○ | | |
| 5 | | ○ | | | | | ○ | |
| 6 | | | ○ | | | ○ | | |
| 7 | | | ○ | | | | ○ | |

## (2) Description for Each Handshaking Mode

① Mode No.0

- Transmission data control:
  No handshaking is carried out between the 2533 power meter and the personal computer. "X-off" and "X-on" codes from the personal computer are handled as data and CB (CTS) and CC (DSR) signals are ignored.
- Receiving data control:
  No handshaking is carried out between the 2533 power meter and the personal computer. When the receiving buffer in the 2533 power meter becomes full, overflow data is lost and CD (DTR) and CA (RTS) signals go TRUE.
  No handshaking is carried out between the 2533 power meter and the personal computer. When the receiving buffer in the 2533 power meter becomes full, overflow data is lost and CD (DTR) and CA (RTS) signals go TRUE.

(Note) The personal computer program must operate so that the buffers in the 2533 power meter and the personal computer do not become FULL.

② Mode No.1

- Transmission data control:
  Software handshaking is carried out between the 2533 power meter and a personal computer. When the 2533 power meter receives an "X-off" code from the personal computer during data transmission, data transmission stops. When the power meter receives "X-on" code following above, data transmission resumes. The CB (CTS) and CC (DSR) signals from the personal computer are ignored.
- Receive data control:
  Software handshaking is carried out between the 2533 power meter and the personal computer. When the available power meter buffer area decreases to 16 bytes, the power meter sends an "X-off" code to the personal computer. When the available power meter buffer area increases to 48 bytes, the power meter sends an "X-on" code.
  The CD (DTR) and CA (RTS) signals are made TRUE.

③ Mode No.2

- Transmission data control:
  Software handshaking is carried out between the 2533 power meter and a personal computer. When the 2533 power meter receives the "X-off" code from the personal computer while it is transmitting data, data transmission stops. When the power meter receives the next "X-on" code, the power meter resumes sending data. The CB (CTS) and CC (DSR) signals from the personal computer are ignored.
- Receiving data control:
  Hardware handshaking is carried out between the 2533 power meter and the personal computer. When the available power meter receiving buffer area decreases to 16 bytes, "CD (DTR) = False". When the available buffer area increases to 48 bytes, "CD (DTR) = True". The CA (RTS) signal is fixed at TRUE.

④ Mode No.3:

- Transmission data control:
  Software handshaking is carried out between the 2533 power meter and a personal computer. When the 2533 power meter receives an "X-off" code from the personal computer while transmitting data, data transmission stops. When the power meter receives a subsequent "X-on" code, data transmission resumes. The CB (CTS) and CC (DSR) signals from the personal computer are ignored.
- Receive data control:
  Hardware handshaking is carried out between the 2533 power meter and the personal computer. When the available area in the power meter receiving buffer decreases to 16 bytes, "CA (RTS) = False". When the available buffer area increases to 48 bytes, "CA (RTS) = True". The CD (DTR) signal is fixed at TRUE.

⑤ Mode No.4

- Transmission data control:
  Hardware handshaking is carried out between the 2533 power meter and a personal computer. When "CB (CTS) = False" is satisfied during data transmission, data transmission stops. When "CB (CTS) = True" is again satisfied, the power meter resumes sending data. The codes "X-off" and "X-on" from the personal computer are handled as data and CC (DSR) signal is ignored.

- Receiving data control:
  Hardware handshaking is carried out between the 2533 power meter and the personal computer. When the available area in the power meter receiving buffer decreases to 16 bytes, the power meter makes "CD (DTR) = False". When this available area increases to 48 bytes, "CD (DTR) = True". The CA (RTS) signal is fixed at TRUE.

⑥ Mode No.5

- Transmission data control:
  Hardware handshaking is carried out between the 2533 power meter and a personal computer. When "CB (CTS) = False" is satisfied while the power meter is sending data, data transmission stops. When "CB (CTS) = True" is again satisfied, data transmission resumes. The codes "X-off" and "X-on" from the personal computer are handled as data and CC (DSR) signal is ignored.
- Receiving data control:
  Hardware handshaking is carried out between the 2533 power meter and the personal computer. When the available area in the power meter receiving buffer decreases to 16 bytes, "CA (RTS) = False". When this available area increases to 48 bytes, "CA (RTS) = True". The CD (DTR) signal is fixed to TRUE.

⑦ Mode No.6

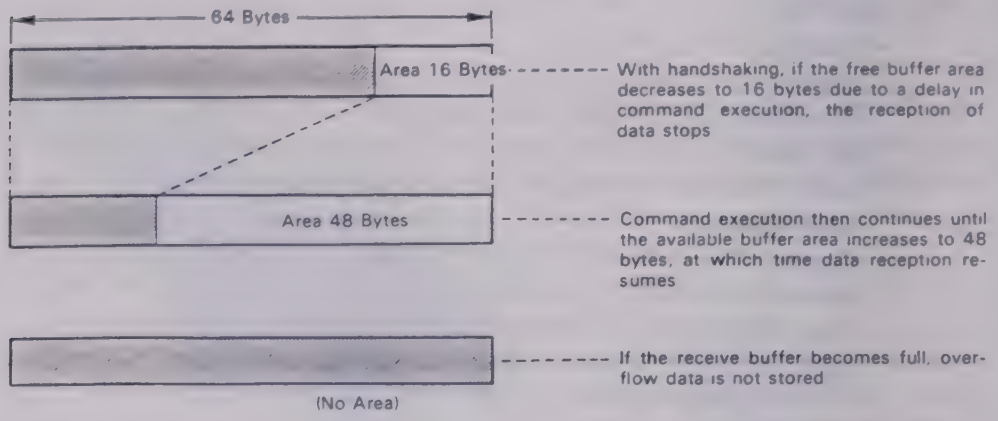
- Transmission data control:
  Hardware handshaking is carried out between the 2533 power meter and a personal computer. When "CC (DSR) = False" is satisfied while the power meter is sending data, data transmission stops. When "CC (DSR) = True" is again satisfied, data transmission resumes. The codes "X-off" and "X-on" from the personal computer are handled as data and CB (CTS) signal is ignored.
- Receiving data control:
  Hardware handshaking is carried out between the 2533 power meter and the personal computer. When the available area in the power meter receiving buffer decreases to 16 bytes, "CD (DTR) = False". When the available buffer area increases to 48 bytes, "CD (DTR) = True". The CA (RTS) signal is fixed at TRUE.

⑧ Mode No.7

- Transmission data control:
  Hardware handshaking is carried out between the 2533 power meter and a personal computer. If "CC (DSR) = False" is satisfied while the power meter is sending data, data transmission stops. After "CC (DSR) = True" is satisfied, the power meter resumes sending data. The codes "X-off" and "X-on" from the personal computer are handled as data and the CB (CTS) signal is ignored.
- Receiving data control:
  Hardware handshaking is carried out between the 2533 power meter and the personal computer. When the available area in the power meter receiving buffer decreases to 16 bytes, "CA (RTS) = False". When the available buffer area increases to 48 bytes, "CA (RTS) = True". The CD (DTR) signal is fixed at TRUE.

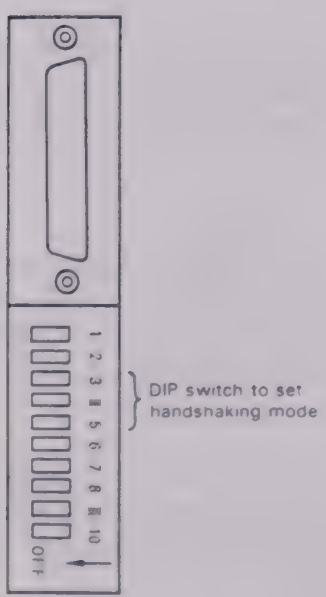
(Note) When the receiving buffer becomes full, overflow data is lost whether or not handshaking is being performed. When buffer area becomes available for data, data storage is resumes.

The 2533 power meter receiving buffer length: 64 bytes


64 Bytes
Area 16 Bytes
With handshaking, if the free buffer area decreases to 16 bytes due to a delay in command execution, the reception of data stops
Area 48 Bytes
Command execution then continues until the available buffer area increases to 48 bytes, at which time data reception resumes
If the receive buffer becomes full, overflow data is not stored
(No Area)

### (3) Procedure for Setting Each Handshaking Mode

Set a handshaking mode with No.3 to No.5 poles of the DIP switch. The DIP switch is located on the rear panel of the 2533 power meter beside the RS-232-C interface connector.




| DIP Switch No | 3 | 4 | 5 | Handshaking Mode |
|---|---|---|---|---|
| DIP switch status | ON | ON | ON | Mode No.0 |
| | ON | ON | OFF | Mode No.1 |
| | ON | OFF | ON | Mode No.2 |
| | ON | OFF | OFF | Mode No.3 |
| | OFF | ON | ON | Mode No.4 |
| | OFF | ON | OFF | Mode No.5 |
| | OFF | OFF | ON | Mode No.6 |
| | OFF | OFF | OFF | Mode No.7 |

Figure 2.2 Handshaking Setting in DIP Switch

# 2.3 Communication Data Format

**(1) Data Format Setting**

The 2533 power meter built-in RS-232-C interface carries out communications with the start/stop system. The start/stop system puts a start bit to the head of a character each time a character is transmitted and then adds in turn the data bits, parity bit and stop bit (see Figure 2.3).

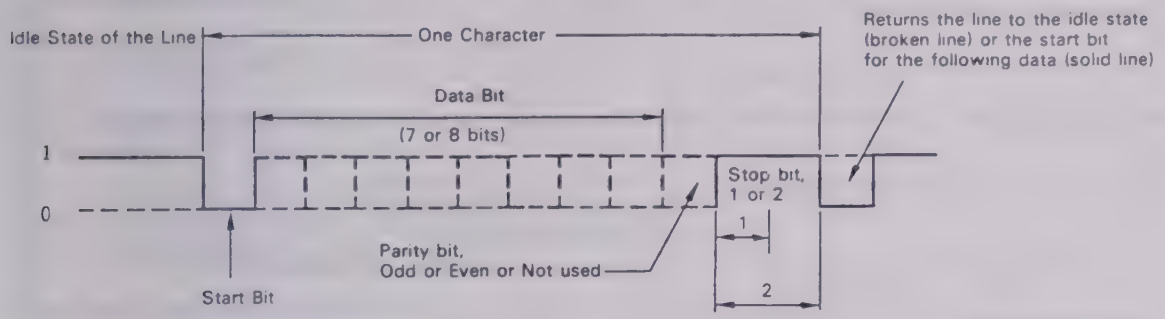

Idle State of the Line
One Character
Returns the line to the idle state (broken line) or the start bit for the following data (solid line)
Data Bit
(7 or 8 bits)
1
0
Stop bit, 1 or 2
1
2
Parity bit, Odd or Even or Not used
Start Bit

**Figure 2.3 Communication Data Format**

**(2) Setting of Conditions for Data Transfer**

Set the data mode, data transfer rate, and data format (start bit, data length, parity, and stop bit) with the DIP switch located beside the RS-232-C interface connector. Make settings with the power turned OFF.

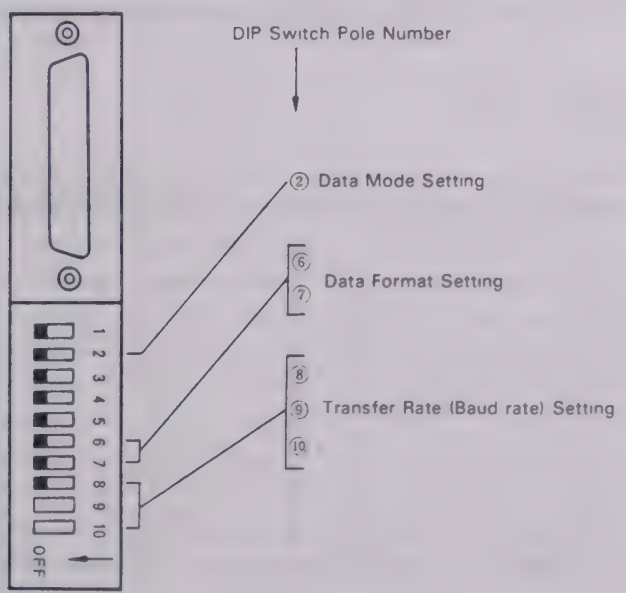



**Figure 2.4 DIP Switch Settings**

② Data Mode Setting
Pole No.2 ON.....for Normal Mode
Pole No.2 OFF.....for Talk-Only Mode
Relationships between each mode and functions are as listed below.

**Table 2.3 Modes and Functions**

| Mode | | Functions |
|---|---|---|
| Normal Mode | Setting Functions | • Voltage or current range settings<br>• Digital displays selection<br>• Measuring mode designation<br>• Scaling factor setting<br>• Operational control to integrating function (option) |
| | Data Output Functions | • Output of measured/computed data<br>• Output of set value data<br>• Output of error codes<br>• Output of status byte |
| Talk-Only Mode | Data Output Functions | • Output of measured/computed data |

⑥ ⑦ Data Format Settings

| DIP Switch Poles | | Start Bit | Data Length | Parity Bit | Stop Bit |
|---|---|---|---|---|---|
| No.6 | No.7 | | | | |
| ON | ON | 1 | 8 | No | 1 |
| ON | OFF | 1 | 7 | Odd | 1 |
| OFF | ON | 1 | 7 | Even | 1 |
| OFF | OFF | 1 | 7 | No | 2 |

⑧ ⑨ ⑩ Data Transfer Rate

| DIP Switch Poles | | | Transfer Rate (Baud rate) |
|---|---|---|---|
| No.8 | No.9 | No.10 | |
| ON | ON | ON | 75 bps |
| ON | ON | OFF | 150 bps |
| ON | OFF | ON | 300 bps |
| ON | OFF | OFF | 600 bps |
| OFF | ON | ON | 1200 bps |
| OFF | ON | OFF | 2400 bps |
| OFF | OFF | ON | 4800 bps |
| OFF | OFF | OFF | 9600 bps |

## 2.4 Connection to Personal Computer

To connect the 2533 power meter to a personal computer, use the DIP switch to set the handshaking mode, data transfer rate, data format, etc. so they match the personal computer conditions (see 2.3 "Communication Data Format").

Make settings with power turned OFF.

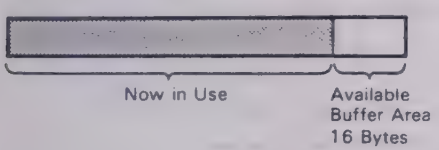
Use the specified interface cable.

## 2.5 Data Control

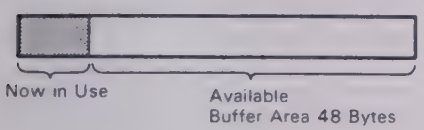
Data can be sent from a personal computer even where handshaking is performed during receive data control.

In this case, overflow data is lost regardless of the handshaking if the receive buffer becomes full. If free buffer area becomes available, data is again stored.

Receiving buffer length = 64 bytes




If the available area in the buffer decreases to 16 bytes during handshaking due to delay in transfer of data to the power meter, data reception stops.

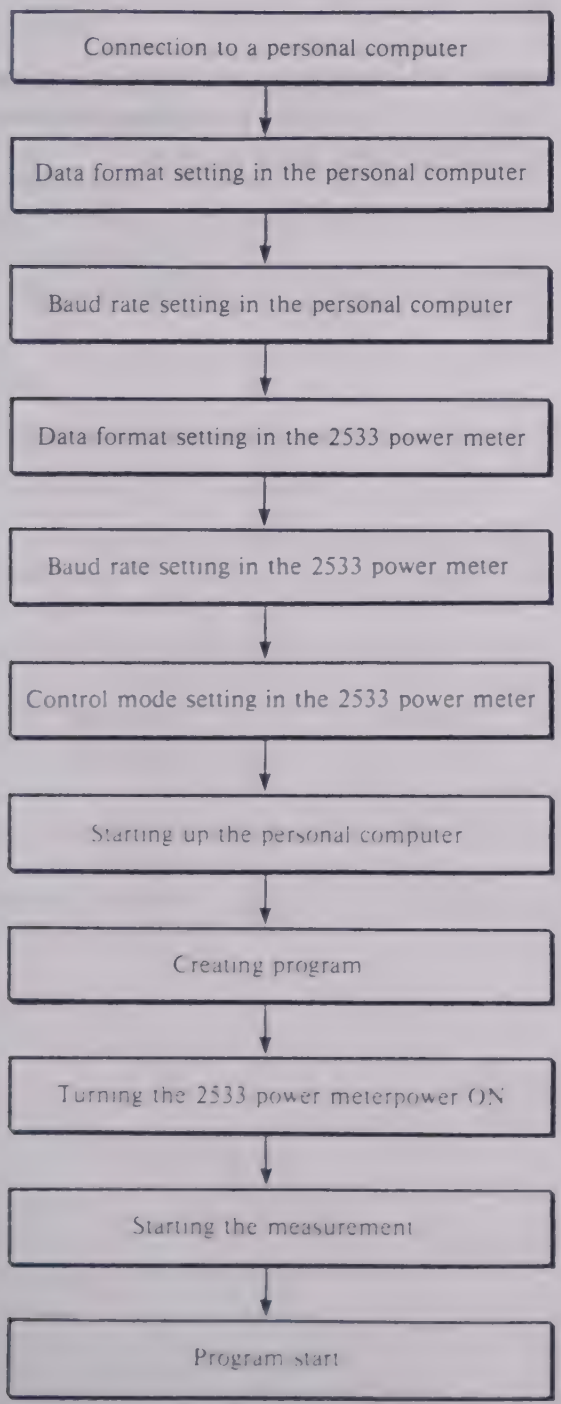



After the above status, when the available area of the buffer increases to 48 bytes as a result of continuing data transfer into the power meter, data reception resumes.

If the buffer becomes full, the overflow data is lost regardless of handshaking

# 3. REMOTE CONTROL VIA RS-232-C INTERFACE

## 3.1 General Procedure


Connection to a personal computer
Data format setting in the personal computer
Baud rate setting in the personal computer
Data format setting in the 2533 power meter
Baud rate setting in the 2533 power meter
Control mode setting in the 2533 power meter
Starting up the personal computer
Creating program
Turning the 2533 power meterpower ON
Starting the measurement
Program start

## 3.2 Basic Format for Programming

The 2533 digital power meter is remotely controlled by program instruction (commands and parameters) sent from the personal computer).

The format for the program consists of command, parameter and terminator, and it is set using ASCII codes.

| Command | Parameter | Terminator |
|---|---|---|
| AV | ℓ | ○ CR + LF or<br>○ LF or<br>○ ; |

▪ Select any one of the above terminators

- Command..... Define it with two upper case alphabetic characters.
- Parameter ASCII codes for a numerical value.

# 3.3 Program Data

### 3.3.1 Setting Voltage and Current Ranges (RANGE)

## AV (Auto Voltage range)

## AA (Auto current (A) range)

**Function** Designates to set the voltage and current ranges whether to automatic range setting mode or fixed range mode.

**Syntax**
AV ℓ <terminator>
AA ℓ <terminator>  ℓ = 0, or 1

**Comment**
- Fixed range mode when ℓ = 0. The key lamp is extinguished.
- Automatic range setting mode when ℓ = 1. The key lamp is lit.
- When ℓ is not set or is set to 2 or higher value, a syntax error occurs and the range mode does not change and is ignored. Error number is 101.
- The default value is · = 0 (fixed range mode). When battery backed-up, settings in local mode defaults to initial value.
- This function corresponds to [0 AUTO] key operation in local mode.

## RV (set Range Voltage)

**Function** A voltage range is set in a fixed range mode.

**Syntax** RV ℓ <terminator>  ℓ = 4 to 9

**Comment**
- Effective in a fixed range mode and ignored in an automatic range setting mode (syntax error No.107 occur). It is recommended to be combined with AV0 command.
- The meaning of ℓ is as follows. The lamp of a set voltage range goes on.
  RV4 ..... 30 V range  RV7 ..... 150 V range
  RV5 ..... 60 V range  RV8 ..... 300 V range
  RV6 ..... 100 V range  RV9 ..... 600 V range
- When ℓ is set to 3 or less or 10 or more, a syntax error occurs, and the range setting is not changed but is ignored. Error number is 101.
- The local mode setting will be an initial setting.
- This function corresponds to operation of [▼] or [▲] key in VOLTAGE RANGE (V) in local mode.

## RA (set Range current (A))

**Function** A current range is set in a fixed range mode.

**Syntax** RA ℓ <terminator>  ℓ = 4 to 9 (AC model)
ℓ = 5 to 9 (DC/AC model)

**Comment**

- Effective in a fixed range mode and ignored in an automatic range setting mode (syntax error No.107 occurs). It is recommended to be combined with AA0 command.
- The meaning of ℓ is as follows. The lamp of a set voltage range goes on.
  RV4 ..... 0.5 A range* RV7 ..... 5 A range
  RV5 ..... 1 A range RV8 ..... 10 A range
  RV6 ..... 1 A range RV9 ..... 20 A range
  *: Only for AC model (If 0.5A range is set in DC/AC model, a syntax error occurs.)
- When ℓ is set to 3 or less or 10 or more, a syntax error occurs, and the range setting does not change but ignored. Error number is 101.
- The local mode setting will be an initial setting.
- This function corresponds to operation of [▼] or [▲] key in CURRENT RANGE (A) in local mode.

**PC-9801 Personal Computer**

**Sample Program**

```
10  OPEN "COM:N81NN" AS #1
20  PRINT #1,"DA3;DB2;DC1"
30  PRINT #1,"OL"
40  FOR I=1 TO 7
50    LINE INPUT #1,L$
60    PRINT L$
70  NEXT I
80  CLOSE
90  END
```

**[Read Data]**

```
DA3 ;DB2 ;DC1
EA1;EB1;EC1
RV9;AV0
RA9;AA0
DS0;WR0;MN0;FL0;AG0;SC0;HD0
KV1.0000;KA1.0000;KW1.0000
TM00000
```

IBM PC

**Sample Program**

```
10 DIM L$(80)
20 OPEN "COM1:9600,N,8,1,CS0,DS0,LF" AS #1
30 PRINT #1,"DA3;DB2;DC1"
40 PRINT #1,"OL"
50 FOR I=1 TO 7
60   LINE INPUT #1,L$
70   IF MID$(L$,1,1) <> CHR$(&HA)
          THEN PRINT L$
          ELSE PRINT MID$(L$,2,80)
80 NEXT I
90 CLOSE #1
100 END
```

[Read Data]

```
DA3 ;DB2 ;DC1
EA1;EB1;EC1
RV9;AV0
RA9;AA0
DS0;WR0;MN0;FL0;AG0;SC0;HD0
KV1.0000;KA1.0000;KW1.0000
TM00000
```

### 3.3.2 Selecting Digital Display (DISPLAY)

## DA, DB, DC (set Display A, B, C function)

**Function** Selects FUNCTION of digital display of DISPLAY A, DISPLAY B and DISPLAY C.

**Syntax**

DA ℓ <terminator> ℓ = 1 to 3
DB m <terminator> m = 1 to 4
DC n <terminator> n = 1 to 10

**Comment**

- The meaning of ℓ, m and n is as follows:

| Parameter ℓ, m, n | DAℓ | DBm | DCn |
|---|---|---|---|
| 1 | V (voltage) display | V (voltage) display | V (voltage) display |
| 2 | A (current) display | A (current) display | A (current) display |
| 3 | W (effective power) display | W (effective power) display | W (effective power) display |
| 4 | — | INTEG TIME (integration time) display | var (reactive power) display |
| 5 | — | — | VA (apparent power) display |
| 6 | — | — | PF (power factor) display |
| 7 | — | — | Hz (V1) (voltage frequency) display |
| 8 | — | — | Hz (A1) (current frequency) display |
| 9 | — | — | Wh (watthour) display |
| 10 | — | — | Ah display |

Note: If ";" is used as a terminator, FUNCTION and ELEMENT combination errors are only indicated by flashing of the associated LED. Combination errors occurring where LF or CR.LF is used as a terminator are indicated by error "101."
(Example)
If "DA1 ; DB1 ; DC4 ; DB2" is executed, the DC4 LED will flash to indicate that the DC4 is missplaced (not in alphabetical order).

## EA, EB, EC (set Element A, B, C)

**Function** Selects ELEMENTS of digital displays of DISPLAY A, DISPLAY B and DISPLAY C.

**Syntax**

EA ℓ <terminator>
EB ℓ <terminator>
EC ℓ <terminator> ℓ = 1 to 4

**Comment** The meaning of ℓ is as follows.

ℓ1 ..... ELEMENT 1

ℓ2 ..... ELEMENT 2

ℓ3 ..... ELEMENT 3

ℓ4 ..... ELEMENT Σ

- Ineffective for single phase model 2533 11.
- ℓ = 2 is ineffective for three phase three-wire model 2533 12.

PC-9801

**Sample Program**

```
10  OPEN "COM:N81NN" AS #1
20  PRINT #1,"DA3;DB2;DC1"
30  PRINT #1,"OL"
40  FOR I=1 TO 7
50    LINE INPUT #1,L$
60    PRINT L$
70  NEXT I
80  CLOSE
90  END
```

[Read Data]

```
DA3 ;DB2 ;DC1
EA1;EB1;EC1
RV9;AV0
RA9;AA0
DS0;WR0;MN0;FL0;AG0;SC0;HD0
KV1.0000;KA1.0000;KW1.0000
TM00000
```

IBM PC

**Sample Program**

```
10 DIM L$(80)
20 OPEN "COM1:9600,N,8,1,CS0,DS0,LF" AS #1
30 PRINT #1,"DA3;DB2;DC1"
40 PRINT #1,"OL"
50 FOR I=1 TO 7
60   LINE INPUT #1,L$
70   IF MID$(L$,1,1) <> CHR$(&HA)
          THEN PRINT L$
          ELSE PRINT MID$(L$,2,80)
80 NEXT I
90 CLOSE #1
100 END
```

[Read Data]

```
DA3 ;DB2 ;DC1
EA1;EB1;EC1
RV9;AV0
RA9;AA0
DS0;WR0;MN0;FL0;AG0;SC0;HD0
KV1.0000;KA1.0000;KW1.0000
TM00000
```

### 3.3.3 Designating Measurement Mode (MODE)

## WR (WiRing mode)

**Function** Designates whether the three phase four-wire model 2533 13 is wired with three phase three-wire or three phase four-wire system.

**Syntax** WR ℓ <terminator> ℓ = 0 or 1

**Comment**

- Effective only for three-phase four-wire model 2533 13.
- The meaning of ℓ is as follows.
  WR 0 is set when wired with three phase three-wire system. (lamp for 3P3W key goes off)
  WR 1 is set when wired with three phase four-wire system. (lamp for 3P4W key goes off)
- The function does not change over the wiring itself but changes over the analog addition input according to the wiring.
- The local mode setting will be the initial setting.
- When ℓ is not set or is set to 2 or more, a syntax error occurs. The setting mode is not changed but is ignored. Error number is 101.
- This function corresponds to operation of WIRING key in local mode.

## MN (MeaN)

**Function** Designates whether the voltage is measured in rms value (RMS) or in rectified mean (MEAN) value.

**Syntax** MN ℓ <terminator> ℓ = 0 or 1

**Comment**

- The meaning of ℓ is as follows.
  MN 0 ... RMS (lamp or VOLT key goes on)
  MN 1 ... MEAN (lamp for VOLT key goes off)
- The local mode setting will be an initial setting.
- When ℓ is not set or is set to 2 or more, a syntax error occurs. The setting mode is not changed but is ignored. Error number is 101.
- This function corresponds to operation of VOLT key in local mode.

## FL (FiLter)

**Function** Changes over the measurement response time (FILTER FAST 0.4 s/FILTER SLOW 2 s).

**Syntax** FL ℓ <terminator> ℓ = 0 or 1

**Comment**

- The meaning of ℓ is as follows:
  FL 0 .... FILTER FAST (lamp for FILTER key goes off)
  FL 1 .... FILTER SLOW (lamp for FILTER key goes on)
- The local mode setting will be an initial setting.
- When ℓ is not set or is set to 2 or more, a syntax error occurs. The setting mode is not changed but is ignored. Error number is 101.
- This function corresponds to operation of FILTER key in local mode.

## AG (AveraGing)

**Function** Designates whether or not to subject voltage, current and power measurement to exponential averaging.

**Syntax** AG ℓ <terminator> ℓ = 0 or 1

**Comment**

- The meaning of ℓ is as follows:
  AG 0 .... Exponential averaging is not made (lamp for [0 AVG] key goes off)
  AG 1 .... Exponential averaging is made (lamp for [0 AVG] key goes on)
- The local mode setting will be an initial setting.
- When ℓ is not set or is set to 2 or more, a syntax error occurs.
  The setting mode is not changed but is ignored. Error number is 101.
- This function corresponds to operation of [0 AVG] key in local mode.

## SC (SCaling)

**Function** Designates whether to display a measured value itself (SCALING OFF) or a product of measred value and scaling factor (SCALING ON).

**Syntax** SC ℓ <terminator> ℓ = 0 or 1

**Comment**

- The meaning of ℓ is as follows.
  SC 0 ....SCALING OFF (lamp for [0 SCAL/MG] key goes off)
  SC 1 ....SCALING ON (lamp for [0 SCAL/MG] key goes on)
- The local mode setting will be an initial setting.
- When ℓ is not set or is set to 2 or more, a syntax error occurs. The setting mode is not changed but is ignored. Error number is 101.
- This function corresponds to operation of [0 SCAL/MG] key in local mode.

**PC-9801 Personal Computer**

**Sample Program**

```
10  OPEN "COM:N81NN" AS #1
20  PRINT #1,"WR1;MN1;FL1;AG1;SC1"
30  PRINT #1,"OL"
40  FOR I=1 TO 7
50    LINE INPUT #1,L$
60    PRINT L$
70  NEXT I
80  CLOSE
90  END
```

**[Read Data]**

```
DA1 ;DB2 ;DC3
EA1;EB1;EC1
RV9;AV0
RA9;AA0
DS0;WR1;MN1;FL1;AG1;SC1;HD0
KV1.0000;KA1.0000;KW1.0000
TM00000
```

IBM PC

**Sample Program**

```
10 DIM L$(80)
20 OPEN "COM1:9600,N,8,1,CS9,DS0,LF" AS #1
30 PRINT #1,"WR1;MN1;FL1;AG1;SC1"
40 PRINT #1,"OL"
50 FOR I=1 TO 7
60   LINE INPUT #1,L$
70   IF MID$(L$,1,1) <> CHR$(&HA)
          THEN PRINT L$
          ELSE PRINT MID$(L$,2,80)
80 NEXT I
90 CLOSE #1
100 END
```

[Read Data]

```
DA1 ;DB2 ;DC3
EA1;EB1;EC1
RV9;AV0
RA9;AA0
DS0;WR1;MN1;FL1;AG1;SC1;HD0
KV1.0000;KA1.0000;KW1.0000
TM00000
```

## HD (sample HolD)

**Function** Designates whether sampling is allowed to run freely (approx. 2.5 times/s) or is held.

**Syntax** HD ℓ <terminator>  ℓ = 0 or 1

**Comment**

- The meaning of ℓ is as follows.
  HD 0 .... Sampling free run (lamp for [HOLD] key goes off)
  HD 1 .... Sampling hold (lamp for [HOLD] key goes on)
- When ℓ is not set or is set to 2 or more, a syntax error occurs. The sampling mode is not changed but ignored. Error number is 101.
- The local mode setting will be an initial setting.
- This function corresponds to operation of [HOLD] key in local mode.

## ST (STart)

**Function** At sampling hold, receiving ST command activates a measurement once, updates data displays and outputs the data.

**Syntax** ST <terminator>

**Comment**

- Effective at sampling hold. Ignored at sampling free run. It is recommended to be combined with HD 1 command.
- This function corresponds to operation of [MAN] key in local mode.
- Receiving ST command in sampling free run mode causes a syntax error and outputs error code 107.
- Receiving ST command during data output (BUSY) with OL command or OE command causes a syntax error (page 4-6).

**PC-9801 Personal Computer**

**Sample Program**

```
10  OPEN "COM:N81NN" AS #1
20  PRINT #1,"RV6;AA1;HD1"
30  PRINT #1,"ST"
40  PRINT #1,"OD"
50    LINE INPUT #1,D$
60    PRINT D$
70  CLOSE
80  END
```

**[Read Data]**

```
DA1 EA1NV   , 00000.00E+0,DB2 EB1NA   , 000.0000E+0,DC3 EC1NW   , 00000.00E
```

IBM PC

**Sample Program**

```
10 DIM D$(80)
20 OPEN "COM1:9600,N,8,1,CS0,DS0,LF" AS #1
30 PRINT #1,"RV6;AA1;HD1"
40 PRINT #1,"ST"
50 PRINT #1,"OD"
60   LINE INPUT #1,D$
70   IF MID$(D$,1,1) <> CHR$(&HA)
          THEN PRINT D$
          ELSE PRINT MID$(D$,2,80)
80 CLOSE #1
90 END
```

[Read Data]

```
DA1 EA1NV  , 00000.00E+0,DB2 EB1NA  , 000.0000E+0,DC3 EC1NW  , 00000.00E+0
```

## DM (DeMag)

**Function** Demagnetizes DC-CT (current transformer) core.

**Syntax** DM <terminator>

**Comment**

- Used only for DC/AC model.
- If a DM command is received, DC-CT core is demagnetized for about 5 seconds.
- During demagnetizing operation, A/D is stopped and commands other than OE command, and all keys are ignored.
- After demagnetizing, A/D end status is set. In a hold state, the measured and computated data are provided.
- This function corresponds to operation of LOCAL/DEMAG key operation in local mode.

(Note) Demagnetization using DEMAG key is valid only in local mode. When a DM command is used, both remote and local modes are valid.

### 3.3.4 Setting Scaling (SCALING) Factor

## KA (K×Ampere)

## KV (K×Voltage)

## KW (K×Wattage)

**Function** Sets a scaling factor for a measured value of voltage, current or power.

**Syntax**

KV □□□□□□<terminator>
KA □□□□□□<terminator>
KW □□□□□□<terminator>
Scaling factor

**Comment**

- The scaling factor setting range is 0.0001 to 10000. Set the scaling factor with a 6 digit (including a decimal point). ASCII characters string.
- When the specified setting range is exceeded or the number of digits is 5 or less or 7 or more a syntax error occurs. The scaling factor is not changed but ignored. Error number is 101.
- The local mode setting will be an initial setting.
- This function corresponds to operation of SET PARAMETER in local mode.

**PC-9801 Personal Computer**

**Sample Program**

```
10  OPEN "COM:N81NN" AS #1
20  PRINT #1,"KV20.000;KA30.000;KW1.0000"
30  PRINT #1,"SC1;OL"
40  FOR I=1 TO 7
50    LINE INPUT #1,L$
60    PRINT L$
70  NEXT I
80  CLOSE
90  END
```

**[Read Data]**

```
DA1 ;DB2 ;DC3
EA1;EB1;EC1
RV9;AV0
RA9;AA0
DS0;WR0;MN0;FL0;AG0;SC1;HD0
KV20.000;KA30.000;KW1.0000
TM00000
```

IBM PC

**Sample Program**

```
10 DIM L$(80)
20 OPEN "COM1:9600,N,8,1,CS0,DS0,LF" AS #1
30 PRINT #1,"KV20.000;KA30.000;KW1.0000"
40 PRINT #1,"SC1;OL"
50 FOR I=1 TO 7
60   LINE INPUT #1,L$
70   IF MID$(L$,1,1) <> CHR$(&HA)
          THEN PRINT L$
          ELSE PRINT MID$(L$,2,80)
80 NEXT I
90 CLOSE #1
100 END
```

[Read Data]

```
DA1 ;DB2 ;DC3
EA1;EB1;EC1
RV9;AV0
RA9;AA0
DS0;WR0;MN0;FL0;AG0;SC1;HD1
KV20.000;KA30.000;KW1.0000
TM00000
```

### 3.3.5 Setting Information/Error Code Output Command

## OL (Output List)

**Function** Outputs setting data.

**Syntax** OL <terminator>

**Comment**
- Receiving OL command, output the setting data.

**PC-9801 Personal Computer**

**Sample Program**

```
10  OPEN "COM:N81NN" AS #1
20  PRINT #1,"OL"
30  FOR I=1 TO 7
40    LINE INPUT #1,L$
50    PRINT L$
60  NEXT I
70  CLOSE
80  END
```

**[Read Data]**

```
DA1 ;DB2 ;DC3
EA1;EB1;EC1
RV9;AV0
RA9;AA0
DS0;WR0;MN0;FL0;AG0;SC0;HD0
KV1.0000;KA1.0000;KW1.0000
TM00000
```

**IBM PC**

**Sample Program**

```
10 DIM L$(80)
20 OPEN "COM1:9600,N,8,1,CS0,DS0,LF" AS #1
30 PRINT #1,"OL"
40 FOR I=1 TO 7
50   LINE INPUT #1,L$
60   IF MID$(L$,1,1) <> CHR$(&HA)
           THEN PRINT L$
           ELSE PRINT MID$(L$,2,80)
70 NEXT I
80 CLOSE #1
90 END
```

**[Read Data]**

```
DA1 ;DB2 ;DC3
EA1;EB1;EC1
RV9;AV0
RA9;AA0
DS0;WR0;MN0;FL0;AG0;SC0;HD0
KV1.0000;KA1.0000;KW1.0000
TM00000
```

## OE (Output Error code)

**Function** Outputs an error number.

**Syntax** OE <terminator>

**Comment**
- When OE command is received, output an error number.
- When no error is produced, an error number 000 is output.
- When an error number output, the error number returns to 000.

| Error No. | Description | Operation of 2533 |
|---|---|---|
| 000 | No error (normal) | • "ERR 000" is sent when OE command is received. |
| 100 | Command error (undefined command is received). | • "ERR 100" is sent when OE command is received.<br>• Syntax error status is set. |
| 101 | Parameter error<br>• Parameter is beyond specified range.<br>• DISPLAY function (FUNCTION) and element (ELEMENT) are combined erroneously. | • "ERROR 101" is sent when OE command is received.<br>• In case of erroneous combination of function and element, key lamps for designated function and element flash.<br>• Syntax error status is set. |
| 102 | Integration time is set during integration.<br>Scaling is set during integration.<br>Timer is set out of integration mode. | • "ERR 102" is sent when OE command is received.<br>• Syntax error status is set. |
| 103 | Result of scaling factor computation overflows from display digits. | • "(8)888888" appears on relevant display section.<br>• "ERR 103" is sent when OE command is received.<br>• OVER (data overflow) is set. |
| 104 | Measurement data overflow<br>(Input of A-D converter exceeds 140% of range rating.) | • "999999" appears on relevant display section.<br>• "ERR 104" is sent when OE command is received.<br>• OVER (data overflow) is set. |
| 105 | No measurement data | • "(–) – – – – – –" appears on relevant display section.<br>• "ERR 105" is sent when OE command is received.<br>• OVER (data overflow) is set. |
| 106 | Voltage peak value over<br>(Voltage peak value exceeds 250% of range rating.) | • Voltage PEAK OVER lamp goes on.<br>• "ERR 106" is sent when OE command is received.<br>• OVER (data overflow) is set. |
| 107 | While message (setting data and error code) is being output, A-D conversion is started from RS-232-C controller in sample HOLD mode or A-D conversion is started from RS-232-C controller in sample free run mode.<br>When scaling was being set, scaling or timer was set from RS-232-C controller.<br>When timer was being set, scaling or timer was set from RS-232-C controller.<br>When recorder was in automatic range set mode, range was set from RS-232-C controller. | • "ERR 107" is sent when OE command is received.<br>• Syntax error status is set. |
| 108 | Current peak value over<br>(Current peak value exceeds 350% of range rating.) | • Current PEAK OVER lamp goes on.<br>• "ERR 108" is sent when OE command is received.<br>• OVER (data overflow) is set. |
| 109 | Low frequency | • "9999999" appears on relevant display section.<br>• "ERR 109" is sent when OE command is received.<br>• OVER (data overflow) is set. |
| 110 | Integrator was instructed to start operation.<br>When it was already reserved in another mode. | • "ERR 110" is sent when OE command is received.<br>• Syntax error status is set. |

| Error No. | Description | Operation of 2533 |
|---|---|---|
| 111 | Integrator was instructed to start operation when the measurement data is overflowing. | • "ERR 111" is sent when OE command is received.<br>• Syntax error status i set. |
| 112 | When data was being integrated, an attempt to start integration was made. An attempt to integrate data was made when integrator was not in integration mode. | • Syntax error status is set.<br>• "ERR 112" is sent when OE command is received. |
| 113 | Integrated data overflow. Integration stops. | • "ERR 113" is sent when OE command is received.<br>• Integration END status is set. |
| 114 | An attempt to stop integration was made while integration was not being executed. | • Syntax error status is set.<br>• "ERR 114" is sent when OE command is received. |
| 115 | An attempt to reset integration was made while integration was being executed. | • Syntax error status is set.<br>• "ERR 115" is sent when OE command is received. |
| 116 | An attempt to reset integration was made when the display was not in integration mode. | • "ERR 116" is sent when OE command is received.<br>• Syntax error status is set. |
| 200 | A-D conversion time-out | • Program stop |

### 3.3.6 Mask Designation for Status Byte

## IM (Interrupt Mask)

**Function** Mask designation for status byte

**Syntax** IM $\ell$ <terminator> . $\ell$ = 2 to 30

**Comment**

- Meaning of $\ell$ is as follows:
  $\ell$ = 2 ..... Integration with optional integration function ends.
  $\ell$ = 4 ..... A/D END
  $\ell$ = 8 ..... Syntax error occurs.
  $\ell$ = 16 .... Measured/computed value overrange
  When there is more than one cause for the occurrence of an interrupt, the corresponding values given above are added.
  (Example: $\ell$ = 12 Indicates that both A/D END and syntax errors occurred.)
- The initial value is $\ell$ = 30.
- When the status byte is read once with the ESC S command, the status byte is cleared.
- Integration BUSY cannot be cleared with this command.

Status Byte

| DIO8 | DIO7 | DIO6 | DIO5 | DIO4 | DIO3 | DIO2 | DIO1 |
|---|---|---|---|---|---|---|---|
| 0 | 1 | ERROR | OVER RANGE | SYNTAX ERROR | A/D END | INTEGRA-TION END | INTEGRA-TION BUSY |
| | | | 16 | 8 | 4 | 2 | |

## <ECS> S

**Function** Outputs status byte

**Syntax** <ESC> S <terminator>

**Comment** Receiving this command outputs the status byte from the 2533 power meter.
<ESC> = 1BH

### 3.3.7 Operation Control of Integrating Function (option)

## IS (Integrate Srart)

**Function** Start command for integrating function.

**Syntax** IS <terminator>

**Comment**
- Effective only for Model 2533□□/INTEG provided with integrating function.
- This function corresponds to operation of [START] key in local mode.

## IP (Integrate stoP)

**Function** Stop command for integrating function.

**Syntax** IP <terminator>

**Comment**
- Effective only for Model 2533□□/INTEG provided with integrating function.
- This function corresponds to operation of [STOP] key in local mode.

## IR (Integrate Reset)

**Function** Reset command for integrating function.

**Syntax** IR <terminator>

**Comment**
- Effective only for Model 2533□□/INTEG provided with integrating function.
- This function corresponds to operation of [RESET] key in local mode.

## TM (set integrate TiMer)

**Function** Designates manual mode/timer mode and sets integration time.

**Syntax** TM $h_{10}h_{10}h_1m_{10}m_1$ <terminator> $h_{10}h_{10}h_1m_{10}m_1$ = 00000 to 10000

**Comment**
- Effective only for Model 2533□□/INTEG provided with integrating function.
- Manual mode ..... $h_{10}h_{10}h_1m_{10}m_1$ = 00000.
- Timer mode ..... $h_{10}h_{10}h_1m_{10}m_1$ = 00001 to 10000
  (1 min to 100 h)
- When the setting time is beyond the specified range (more than 10000), a syntax error occurs. ERROR No.101
- If, when scaling or setting the integral time from the panel, the integrator is not in integrating mode, a syntax error with ERROR No. 107 occurs.

## OI (output integrate data)

**Function** Outputs the integrated data at timeout.

**Syntax** OI <terminator>

**Comment**
- If, after finishing integration at timeout, the integrator receives an OI command, it outputs the integrated data.
- Once the integrated data is read, no more data can be read until the next timeout.

### 3.3.8 Remote or Local Control

## <ESC> R

**Function** Brings the power meter to a remote mode through the RS-232-C communication port.

**Syntax** <ESC> R <terminator>

**Comment** When the 2533 power meter is placed in the remote mode, settings cannot be made on the front panel.

## <ESC> L

**Function** Brings the power meter to the local mode by means of the remote RS-232-C interface communication path.

**Syntax** <ESC> L <terminator>

**Comment** The power meter is transferred to local mode from remote mode. In this case, setting on the front panel can be made again.
<ESC> = 1BH

### 3.3.9 To Request to Output Measurement/Computation Data (in Normal Mode Only)

## OD (output data)

**Function** Outputs measurement/computation data.

**Syntax** OD <terminator>

**Comment** When an OD command is received, measurement/computation data is output.

# 3.4 Command List

| Command | Parameter | Function |
|---|---|---|
| AV<br>AA | 0 or 1 | Designates that either the voltage or current range is set in the automatic range setting mode or the fixed range mode. |
| RV | 4 to 9 | Voltage range setting in the fixed range mode. |
| RA | 4 to 9 | Current range setting in the fixed range mode |
| DA | 1 to 3 | Selects functions for digital display A, B, and C. |
| DB | 1 to 4 | |
| DC | 1 to 10 | |
| EA<br>EB<br>EC | 1 to 4 | Selects elements for digital display A, B, and C. |
| WR | 0 or 1 | Designates whether a three-phase three-wire or a three-phase four-wire system is used in three-phase four-wire system model 2533 13. |
| MN | 0 or 1 | Designates whether the voltage is measured as an RMS value or current is measured as an average value. |
| FL | 0 or 1 | Response time selection for measurement<br>FILTER FAST 0.4 second<br>FILTER SLOW 2 seconds |
| AG | 0 or 1 | Designates whether the exponential mean is taken for measurements of voltage, current or power |
| SC | 0 or 1 | Designates that either the measured value (SCALING OFF) or the product of measured value and scaling factor (SCALING ON) is displayed. |
| HD | 0 or 1 | Designates either free run sampling (about 2.5 times/s) or sample hold (HOLD). |
| ST | | When an ST command is received in sample hold, the power meter carries out the measurement once, updates the data display. |
| KA<br>KV<br>KW | (Scaling factor) | Sets the scaling factor for measured values of voltage, current, or power. |
| OL | | Command for setting data output |
| OE | | Command for error No. output |
| OD | | Data output requesting command in other than talk only mode |
| IM | 2 to 30 | Mask designation for status byte |
| IS | | Start command for integration function |
| IP | | Stop command for integration function. |
| IR | | Reset command for integration function. |
| TM | | Designates manual/timer mode and sets integration time |
| <ESC> R | | Sets the 2533 power meter in remote mode. |
| <ESC> L | | Sets the 2533 power meter in local mode |
| <ESC> S | | Outputs the status byte |
| OI | | Outputs the integrate data at timeout |

# 4. DATA OUTPUT FUNCTION

**(1) Data Output Method**

The data output method includes the following two.

- Normal Mode:

  Setting and data output can be carried out in this mode. Commands "OL", "OD", "OE", "OI", and "<ESC> S" are used.

| | | |
|---|---|---|
| Normal Mode (DIP switch No.2 pole = ON) | Setting of voltage or current | Measuring functions |
| | Selection of digital display | |
| | Output of measured/computed data | |
| | Output of setting data | Data output functions |
| | Output of error codes | |
| | Output of integration value | |
| | Output of status byte | |

- Talk-Only Mode:

  Dedicated data output mode.

  Setting cannot be performed. Setting data output, error code output, and status byte output cannot also be carried out.

  Measured/computed data are output with sampling in FREE RUN mode.

| | | |
|---|---|---|
| Talk-Only Mode (DIP switch No.2 pole = OFF) | Measured/computed data output | Data output function |

(2) Setting is made on the No.2 pole of the DIP switch located beside the RS-232-C interface connector on the rear panel of the power meter.

For setting procedure, refer to section 2.3 "Communication Data Format".

# 4.1 Output Format for Measured/Computed Data

In Normal mode: The following data are output when "OD" command is received.
In Talk-Only mode: When sampling is in Free Run mode, operation is performed at 400 ms cycle and in sample-hold mode, manual operation is performed.

| 1 ····· 24 | 25 | 26 ····· 49 | 50 | 51 ····· 74 | 75 | 76 |
|---|---|---|---|---|---|---|
| Data of DISPLAY A | , | Data of DISPLAY B | , | Data of DISPLAY C | $C_R$ | $L_F$ |

**<Data of DISPLAY A>**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | A | ℓ | Sp | E | A | m | n | $u_1$ | $u_2$ | $u_3$ | . | p | $d_1$ | $d_2$ | $d_3$ | $d_4$ | $d_5$ | $d_6$ | $d_7$ | $d_8$ | E | p | e | . |

→ DISPLAY B

**FUNCTION**
DA1: V
DA2: A
DA3: W

**UNIT**
V Sp Sp (V)
A Sp Sp (A)
W Sp Sp (W)

Digital data (value, Decimal point)
Polarity (Sp, −)
Mantissa part

Exponent (0, 3, 6)
Polarity (+, −)
Exponent part
E−3:$10^{-3}$(m)
E+0:1
E+3:$10^{3}$ (k)
E+6:$10^{6}$ (M)

**ELEMENT**
EA1: 1
EA2: 2
EA3: 3
EA4: Σ

**Data status**
O :computation overflow data
I : no measured data/overflow measured data
N : normal data

* Sp: space

**<Data of DISPLAY B>**

| 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | B | ℓ | Sp | E | B | m | n | $u_1$ | $u_2$ | $u_3$ | . | p | $d_1$ | $d_2$ | $d_3$ | $d_4$ | $d_5$ | $d_6$ | $d_7$ | $d_8$ | E | p | e | . |

→ DISPLAY C

**FUNCTION**
DB1: V
DB2: A
DB3: W
DB4: INTEG TIME

**UNIT**
V Sp Sp (V)
A Sp Sp (A)
W Sp Sp (W)
H M Sp (Hour Minute)
INTEG TIME

Digital data (value, Decimal point)
Polarity (Sp, −)
Mantissa part

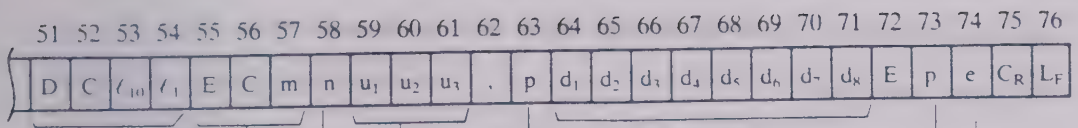
Exponent (0, 3, 6)
Polarity (+, −)
Exponent part

**ELEMENT**
EB1: 1
EB2: 2
EB3: 3
EB4: Σ

**Data status**
O :computation overflow data
I : no measured data/measured data overflow
N : normal data

* Sp: space

<Data of DISPLAY C>




Digital data (value, Decimal point)

Exponent (0, 3, 6)

Polarity (Sp, −)

Polarity (+, −)

Mantissa part

Exponent part

**FUNCTION**

DC1 : V
DC2 : A
DC3 : W
DC4 : var
DC5 : VA
DC6 : PF
DC7 : Hz (V1)
DC8 : Hz (A1)
DC9 : Wh
DC10: Ah

**UNIT**

V Sp Sp (V)
A Sp Sp (A)
W Sp Sp (W)
V A R (var)
V A Sp (VA)
Sp Sp Sp (PF)
H Z Sp (Hz)
W H Sp (Wh)
A H Sp (Ah)
A U X (arbitrary unit)
in case of scaling ON display when power scaling factor is other than 1.0000

**ELEMENT**

EC1: 1
EC2: 2
EC3: 3
EC4: Σ

**Data status**

O :computation overflow data
I : no measured data/measured data overflow
N : normal data

* Sp: space

# 4.2 Setting Information Output Format

When OL command is received, setting information is output as shown below.

### (1) Transfer Sequence

| | | | |
|---|---|---|---|
| Line 1 | Display FUNCTION setting | $C_R$ | $L_F$ |
| Line 2 | Display ELEMENT setting | $C_R$ | $L_F$ |
| Line 3 | Voltage range setting | $C_R$ | $L_F$ |
| Line 4 | Current range setting | $C_R$ | $L_F$ |
| Line 5 | Measurement mode setting | $C_R$ | $L_F$ |
| Line 6 | Scaling factor setting | $C_R$ | $L_F$ |
| Line 7 | Integration time setting | $C_R$ | $L_F$ |

### (2) Output Format

• **Line 1** <display FUNCTION setting>

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | A | ℓ | Sp | : | D | B | m | Sp | : | D | C | $n_{10}$ | $n_1$ | $C_R$ | $L_F$ |

**DISPLAY A**

DA1··· [0 V]
DA2··· [0 A]
DA3··· [0 W]

**DISPLAY B**

DB1··· [0 V]
DB2··· [0 A]
DB3··· [0 W]
DB4··· [0 INTEG TIME]

**DISPLAY C**

DC1··· [0 V]
DC2··· [0 A]
DC3··· [0 W]
DC4··· [0 var]
DC5··· [0 VA]
DC6··· [0 PF]
DC7··· [0 Hz] (V1)
DC8··· [0 Hz] (A1)
DC9··· [0 Wh]
DC10··· [0 Ah]

• **Line 2** <display ELEMENT setting>

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E | A | ℓ | : | E | B | ℓ | : | E | C | ℓ | $C_R$ | $L_F$ |

**DISPLAY A** **DISPLAY B** **DISPLAY C**

ℓ=1··· [0 1] , ℓ=2··· [0 2] , ℓ=3··· [0 3] , ℓ=4··· [0 Σ]

• **Line 3** <voltag range setting>

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| R | V | ℓ | : | A | V | m | $C_R$ | $L_F$ |

RV4... 30V range
RV5... 60V range
RV6... 100V range
RV7... 150V range
RV8... 300V range
RV9... 600V range

AV0... fixed range mode
AV1... automatic range setting mode

• **Line 4** <current range setting>

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| R | A | $\ell$ | ; | A | A | m | $C_R$ | $L_F$ |

RA4... 0.5A range
RA5... 1 A range
RA6... 2 A range
RA7... 5 A range
RA8... 10 A range
RA9... 20 A range

AA0... fixed range mode
AA1... automatic range setting mode

• **Line 5** <measurement mode setting>

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | S | $\ell_1$ | : | W | R | $\ell_2$ | ; | M | N | $\ell_3$ | ; | F | L | $\ell_4$ | ; | A | G | $\ell_5$ | ; | S | C | $\ell_6$ | ; | H | D | $\ell_7$ | $C_R$ | $L_F$ |

$\ell_1$ to $\ell_7$ :0 or 1

DS0: EOI generated on last line only
DS1: EOI generated on each line

WR0: three-phase 3-wire wiring
WR1: three-phase 4-wire wiring

MN0: rms measurement/display
MN1: mean value rectification measurement, rms calibration display

FL0: FILTER FAST
FL1: FILTER SLOW

AG0: averaging OFF
AG1: averaging ON

SC0: scaling OFF display
SC1: scaling ON display

HD0: sample free run status
HD1: sample hold status

• **Line 6** <scaling factor setting>

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| K | V | $v_1$ | $v_2$ | $v_3$ | $v_4$ | $v_5$ | $v_6$ | : | K | A | $a_1$ | $a_2$ | $a_3$ | $a_4$ | $a_5$ | $a_6$ | ; | K | W | $w_1$ | $w_2$ | $w_3$ | $w_4$ | $w_5$ | $w_6$ | $C_R$ | $L_F$ |

**Voltage scaling factor** **Current scaling factor** **Power scaling factor**

Each factor...0.0001 to 10000. (6 characters including Decimal point)

• **Line 7** <integration time setting>

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| T | M | $h_{100}$ | $h_{10}$ | $h_1$ | $m_0$ | $m_1$ | $C_R$ | $L_F$ |

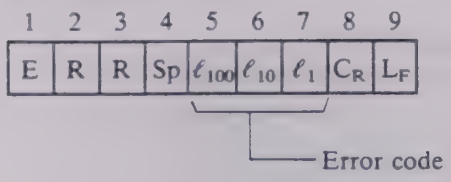
Hour Minute

Integration time... manual mode : 00000
Timer mode : 00001 to 10000 (1 min to 100 h)

# 4.3 Error Code Output Format

When OE command is received, an error code is output.

**(1) Output Format**




**Error Code List**

| Error Code | Description | Operation of 2533 Power Meter |
|---|---|---|
| 000 | No error (normal) | • "ERR 000" is sent when OE command is received. |
| 100 | Command error (undefined command is received). | • "ERR 100" is sent when OE command is received.<br>• Syntax error status is set. |
| 101 | Parameter error<br>• Parameter is beyond specified range.<br>• DISPLAY function (FUNCTION) and element (ELEMENT) are combined erroneously. | • "ERROR 101" is sent when OE command is received.<br>• In case of erroneous combination of function and element, key lamps for designated function and element flash.<br>• Syntax error status is set. |
| 102 | Integration time is set during integration.<br>Scaling was set during integration.<br>Timer was set out of integration mode. | • "ERR 102" is sent when OE command is received.<br>• Syntax error status is set. |
| 103 | Result of scaling factor computation overflows from display digits. | • "(8)888888" appears on relevant display section.<br>• "ERR 103" is sent when OE command is received.<br>• OVER status is set. |
| 104 | Measurement data overflow<br>(Input of A-D converter exceeds 140% of range rating.) | • "(9)999999" appears on relevant display section.<br>• "ERR 104" is sent when OE command is received.<br>• OVER status is set. |
| 105 | No measurement data | • "(−) − − − − − −" appears on relevant display section.<br>• "ERR 105" is sent when OE command is received.<br>• OVER status is set. |
| 106 | Voltage peak value over<br>(Voltage peak value exceeds 250% of rated range.) | • Voltage PEAK OVER lamp goes on.<br>• "ERR 106" is sent when OE command is received.<br>• OVER status is set. |
| 107 | While message (setting data, error code) is being output, A-D conversion is started from RS-232-C controller in sample HOLD mode or A-D conversion is started from RS-232-C controller in sample free run mode.<br>When scaling was being set, scaling or timer was set from RS-232-C controller.<br>When timer was being set, scaling or timer was set from RS-232-C controller.<br>When recorder was in automatic range set mode, range was set from RS-232-C controller. | • "ERR 107" is sent when OE command is received.<br>• Syntax error status is set. |
| 108 | Current peak value overrange<br>(Current peak value exceeds 350% of rated range.) | • Current PEAK OVER lamp goes on.<br>• "ERR 108" is sent when OE command is received.<br>• OVER status is set. |

| Error Code | Description | Operation of 2533 Power Meter |
|---|---|---|
| 109 | Low frequency | • "9999999" appears on relevant display section.<br>• "ERR 109" is sent when OE command is received.<br>• OVER status is set. |
| 110 | Integrator was instructed to start operation when it was already reserved is another mode. | • "ERR 110" is sent when OE command is received.<br>• Syntax error status is set. |
| 111 | Integrator was instructed to start operation when the measurement data is overflowing. | • "ERR 111" is sent when OE command is received.<br>• Syntax error status is set. |
| 112 | When data was being integrated, an attempt to start integration was made.<br>An attempt to integrate data was made when integrator was not in integration mode. | • Syntax error status is set.<br>• "ERR 112" is sent when OE command is received. |
| 113 | Integrated data overflow.<br>Integration stops. | • "ERR 113" is sent when OE command is received.<br>• Integration END status is set. |
| 114 | An attempt to stop integration was made while integration was not executed. | • Syntax error status is set.<br>• "ERR 114" is sent when OE command is received. |
| 115 | An attempt to reset integration was made while integration was being executed. | • Syntax error status is set.<br>• "ERR 115" is sent when OE command is received. |
| 116 | An attempt to reset integration was made when the display was not in integration mode. | • "ERR 116" is sent when OE command is received.<br>• Syntax error status is set. |
| 200 | A-D conversion time-out | • Program stop. |

## 4.4 Status Byte Output Format

The output format of status byte sent by serial poll is as follows.

| DIO8 | DIO7 | DIO6 | DIO5 | DIO4 | DIO3 | DIO2 | DIO1 | | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | ERROR | OVER | Syntax ERROR | A-D END | Integration END | Integration BUSY | $C_R$ | $L_F$ |

- The status byte is output by status byte output command (ESC S).
- DIO6 to DIO2 becoames all zero (''0'') when the status byte is read by the computer.

**(1) ERROR (DIO6)**

Becomes ''1'', when any of the interrupt causes (OVER, syntax ERROR) of a status byte designated by IM command has been generated.

**(2) OVER (DIO5)**

Becomes ''1'' when measured data causes overrange, peak overflow or computation overflow or when measured data are absent.
ERROR (DIO6) also becomes ''1''.
Ineffective when not designated as an interrupt cause by IM command.
Details of the error at this time can be checked by OE command.

**(3) Syntax ERROR (DIO4)**

A syntax error occurs when RS-232-C command received is not defined, the parameter is beyond a specified range or the command cannot be executed because of status of the power meter.
Details of the error at this time can be checked by OE command.

**(4) A-D END (DIO3)**

Becomes ''1'' as soon as the measurement ends by entry of [MAN] key on the front panel or input of RS-232-C ''ST'' command or remote A-D START when the power meter is at a sample hold status.

**(5) Integration END (DIO2)**

Becomes ''1'' when the integration has timed-out in the timer mode of integrating function or the display has overflowed in a manual mode.

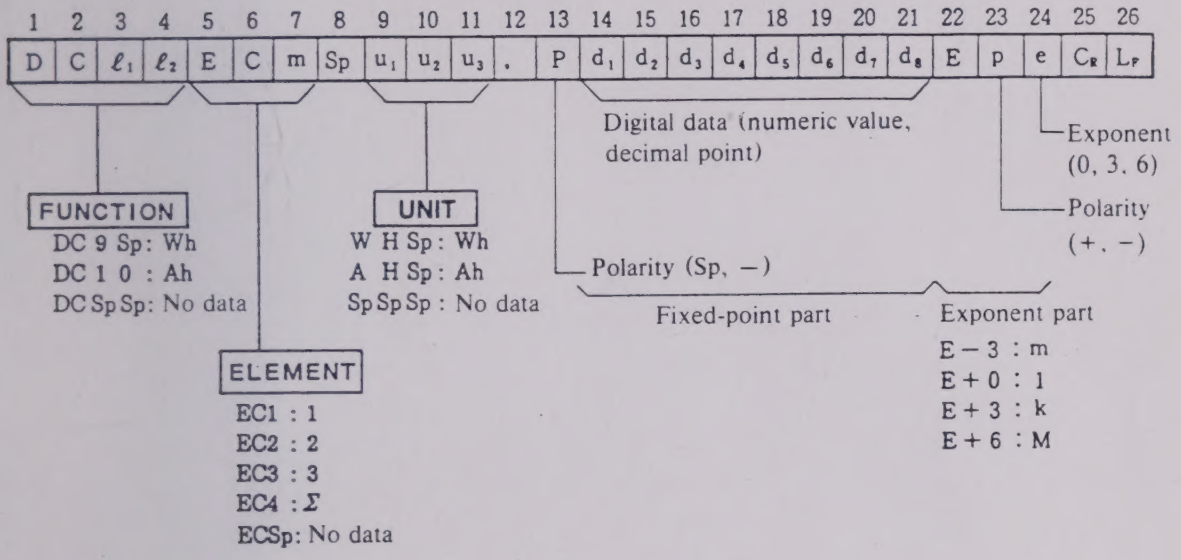
**(6) Integration BUSY (DIO1)**

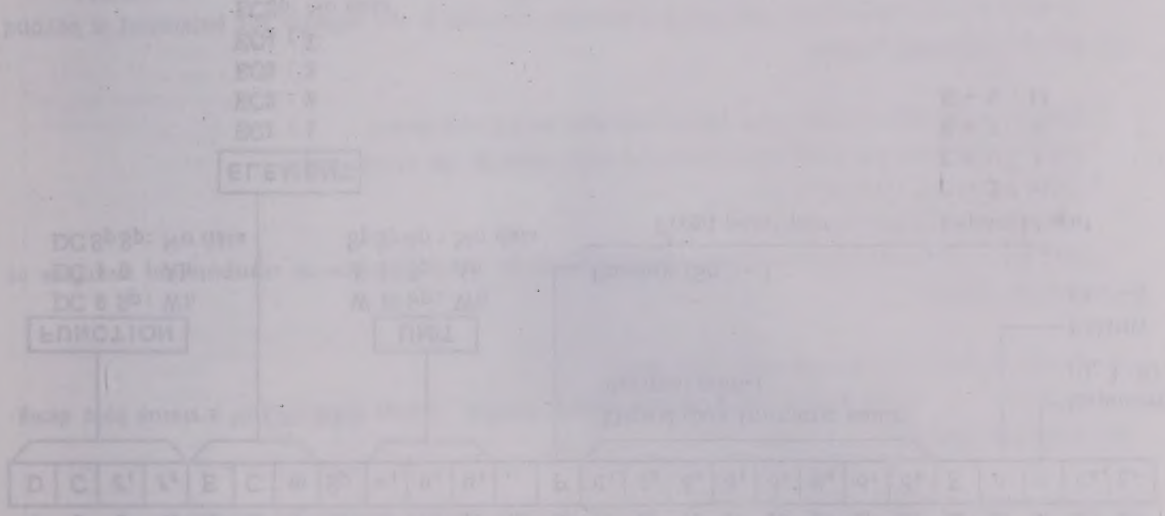
Becomes ''1'' when integration is in progress, or ''0'' when stopped.

## 4.5 Integrated Data Output Format

After finishing integrating at timeout, if the integrator receives an OI command, it outputs the integrated data. Once the integrator reads the integrated data, no more data can be read until the next timeout.

In continuous integration mode, the integrated data immediately before the data is reset is output.


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
D C ℓ1 ℓ2 E C m Sp u1 u2 u3 . P d1 d2 d3 d4 d5 d6 d7 d8 E p e CR LF
Digital data (numeric value, decimal point)
Exponent (0, 3, 6)
Polarity (+, −)
FUNCTION
DC 9 Sp: Wh
DC 1 0 : Ah
DC Sp Sp: No data
UNIT
W H Sp: Wh
A H Sp: Ah
Sp Sp Sp : No data
Polarity (Sp, −)
Fixed-point part
Exponent part
E − 3 : m
E + 0 : 1
E + 3 : k
E + 6 : M
ELEMENT
EC1 : 1
EC2 : 2
EC3 : 3
EC4 : Σ
ECSp: No data



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